



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

A SURVEY OF ARITHMETICAL PROBLEMS ARISING IN VARIOUS OCCUPATIONS

CARL T. WISE

Principal, Lincoln Junior High School, Duluth, Minnesota

I. THE PURPOSE OF THE SURVEY

A few years ago Dr. Frank McMurry, in an address before the Superintendents' Section of the National Education Association, advocated the elimination of all subject-matter which did not meet the needs of present-day social and business life. Dr. McMurry voiced an opinion that had become current among many thoughtful laymen and educators, but, at that time, no scientific studies and investigations had been made as a basis on which to determine just what topics might be considered important, and what might be considered non-essential.

Since that time, however, a large number of extensive and careful investigations have been made into the various subjects of the elementary and secondary schools by scholars and research students in education, which show that in many of our school subjects topics that long ago had become of little or no value as functioning in everyday experiences are still being studied in the schools, while topics that have become of general interest in our present complex civilization, as a result of rapidly changing industrial and economic changes and business practices, are either receiving less consideration than their importance demands, or are neglected entirely.

Because of the universal use of arithmetic in our daily work, much careful study has been given to the subject with the purpose of determining the essentials in arithmetic, so that only the really important and useful phases of the study may be emphasized in the school, thereby saving time for more interesting and useful study. To this work, valuable contributions have been made by Dr. W. A. Jessup, at the University of Iowa; Dr. L. D. Coffman, at the University of Illinois, Professor G. M. Wilson, at the Iowa State College; Professor W. S. Monroe, at the State Normal School, Emporia, Kansas; and others.

In the main, those who have made these studies have followed four general plans to secure their data:

First.—To select problems from a number of standard textbooks. (Monroe's plan)¹

Second.—To submit a list of problems of elimination and enrichment to county and city superintendents asking them to indicate by check mark the topics that should be eliminated and the ones that should be emphasized. (Coffman and Jessup's plan)²

Third.—To submit to men and women engaged in various occupations a questionnaire containing topics in arithmetic asking them to check the topics for which they find use in practical work in arithmetic. (Plan of the Committee of the Iowa State Teachers' Association)³

Fourth.—To have mature people write down the problems, through a period of time, which they have actually solved in connection with their work. (Wilson's plan)⁴ In this study Professor Wilson received 5,036 problems.

In the fall and winter of 1917-18 the writer began a study in arithmetic for the following purposes:

1. To determine what kind of arithmetical problems adults use in their daily work and the frequency of their occurrence.

2. To determine the classification of these problems and the different operations involved in solving them.

3. To obtain suitable problems for making standard tests for all grades—the lists to be determined by graded steps of difficulty and to contain enough problems so that the possibility of pupils memorizing the problems might be avoided.

II. SOURCES OF MATERIAL

The fourth plan mentioned above was followed in collecting the problems. Letters explaining the nature of the undertaking and containing the following instructions were sent to superintendents, principals, and teachers in high schools and the sixth, seventh, and eighth grades, asking their co-operation. The point

¹ WALTER S. MONROE, "A Preliminary Report of an Investigation of the Economy of Time in Arithmetic," *Sixteenth Yearbook of the National Society for the Study of Education*, Part I (1917). Pp. 111-27.

² W. A. JESSUP, "Economy of Time in Arithmetic," *Elementary School Teacher*, Vol. XIV, No. 10, June, 1914.

³ G. M. WILSON, "A Survey of the Social and Business Uses of Arithmetic," *Sixteenth Yearbook of the National Society for the Study of Education*, Part I (1917). Pp. 128-42.

⁴ *Ibid.*, p. 132.

was emphasized that any kind of problem which the parent actually solved was desired, no matter how simple or how difficult. The letter of explanation was as follows:

A STUDY OF PROBLEMS IN ARITHMETIC

The purpose of this study is to make an extensive collection of actual problems which adults solve in their daily work.

To teachers in the sixth, seventh, and eighth grades and to teachers of commercial arithmetic in high schools—

Please make a collection of problems according to the following outline:

1. Collect problems for one week. It is hoped that as large a number of problems as possible may be obtained through each pupil. We desire, if possible, to secure at least one problem each day, or five for the week, from each pupil.

2. Boys collect problems from the father, girls from the mother.

3. The pupil should simply ask the parent whether or not he or she has had any use for arithmetic during the day; if so, what? Then write down the problem. Do not solve it. Please emphasize that we do not want manufactured problems, but problems actually occurring.

The following simply suggests the way the problems should be stated. Any kind of problem that the parent is called upon to solve should be given, no matter how simple or how complicated. Problem: I bought from the grocer two dozen eggs at 37 cents a dozen, one pound of lard at 22 cents, and three cans of peas at 17 cents each. How much was my bill?

4. Have pupils write down the problems on rough paper, and at the end of the week have them copy the problems according to the following form:

Mr. or Mrs.
Occupation (be sure to give it).....
Pupil's name.....
Grade.....School.....City.....State.....

State the problems. Do not solve them.

5. Give your collection to the principal or mail it directly to Professor Daniel Starch, Department of Education, University of Wisconsin, Madison, Wisconsin.

Important: These problems will come as first-class matter. Simply affix one THREE-CENT stamp and write on the envelope, "Collect the balance from the addressee," or send the package by express collect.

In order that the study might cover as wide a range of activities as possible, problems were solicited from schools in Wisconsin, Iowa, Illinois, Missouri, Texas, and California. Many of the superintendents and teachers were unable to assist for various reasons but all told more than 8,000 problems were received and carefully examined. Since the work on these problems was finished, some 2,500 additional problems have been received which will be used for further study.

The writer is indebted to the superintendents, principals, and teachers in the following towns and cities for the problems sent:

San Antonio, Texas; Des Moines, Iowa; Quincy, Illinois; Algoma, Arcadia, Evansville, Green Bay, Horicon, Linden, Madison, Manitowoc, Stoughton, Sun Prairie, and Two Rivers, Wisconsin. Collecting problems from the rural districts was indeed a difficult undertaking and was made possible only through the efforts of Superintendent J. A. Van Natta, of Iowa County, Wisconsin; Superintendent J. H. Steiner, of Adams County, Illinois; and Superintendent A. L. Odenweller, of Henry County, Illinois.

III. METHODS OF CLASSIFICATION

A very simple method of classification was followed. Problems involving only addition were listed under the heading "Addition." The same plan was followed where the problems were so simple as to require only one operation. Problems involving only combinations of the four fundamental processes, addition, subtraction, multiplication, subdivision, were classified under headings showing the two or more operations involved. To illustrate, a problem like the following was listed under the heading "Multiplication": "I bought 6 tons of coal at \$10 a ton. What is the cost?" The following was classified under the heading "Multiplication and Addition": "I bought an automobile for \$1,325, 2 tires at \$50 each, and 18 gallons of gasoline at 22 cents a gallon. How much did it all cost? Write a check for the amount in favor of the Badger Automobile Company." The various combinations of the four fundamental operations under which by far the greatest number of problems were classified is shown in Table II, page 124. Such problems as did not fall into the foregoing classifications were listed under the regular headlines which are commonly followed in standard textbooks, such as, dry measure, cubic measure, percentage, etc.

The writer personally classified nearly one-half of the problems. The remainder was classified by advanced students of Dr. Daniel Starch, Department of Education, University of Wisconsin, working at regular scheduled hours, under the writer's personal direction.

From the beginning, great care was taken to delete problems that were of doubtful validity. This is not always an easy matter to determine, as for instance, one problem called for the number of acres in a triangular field at certain given dimensions. At first, one is likely to question the reliability of such a problem, but such fields are quite common, as where a railroad right-of-way cuts through a farm bounded on two or more sides by a public road. It

TABLE I

OCCUPATIONAL ACTIVITIES OF THE MEN WHOSE PROBLEMS WERE REPORTED

Acid-maker.....	2	Foreman—Switch Engine Crew.....	1
Agent—for Nursery.....	1	Foundryman.....	2
Aluminum Manufacturing.....	1	Freight Checker.....	1
Architect and Engineer.....	1	Freight Handler.....	1
Artist.....	1	Fruit Seller.....	2
Assistant Manager—Manufacturing Company.....	1	Garage-keeper.....	2
Auditor—Oil Company.....	1	Gardener.....	4
Auditor—State Department.....	1	Glassworker.....	1
Auto Repair.....	1	Grain-buyer.....	1
Banker.....	1	Grocer.....	10
Barber.....	3	Hotel Proprietor.....	1
Blacksmith.....	10	Insurance Agent.....	1
Bookkeeper.....	2	Jailor.....	1
Box and Crate-maker.....	1	Janitor.....	1
Brakeman.....	1	Jeweller and Watch-maker.....	1
Brewer.....	2	Laborer.....	37
Bricklayer.....	1	Lawyer.....	2
Business Agent.....	1	Letter Carrier.....	2
Business Manager—Newspaper.....	1	Lumberman.....	1
Butcher.....	4	Manager—Auditing Department.....	1
Buyer—Department Store.....	1	Manager—Coal Docks (Yards).....	1
Cabinet-maker.....	2	Manager—Delivery Company.....	1
Capitalist.....	1	Manager—Lumber Company.....	1
Carpenter.....	19	Manager—Machine Shop.....	1
Cashier.....	1	Manager—Stone Company.....	1
Cattle and Hog Buyer.....	6	Market Master.....	1
Cement Worker.....	1	Marshal and Street Commissioner.....	1
Chauffeur.....	1	Mason.....	2
Chief of Police.....	1	Mechanic.....	9
Cigar Manufacturer.....	1	Mechanical Engineer.....	1
Claim Agent.....	1	Messenger.....	1
Clerk.....	6	Miller.....	2
Clerk—District Court.....	1	Millwright.....	2
Clothier.....	1	Miner.....	4
Coal Dealer.....	1	Minister.....	6
Collector.....	1	Motorman.....	1
County Judge.....	1	Moulder.....	3
County Treasurer.....	1	Moving Picture Operator.....	1
Dairyman.....	4	Night Watchman.....	3
Deputy Sheriff.....	1	Nurseryman.....	1
Display Compositor.....	2	Oil Dealer.....	1
Draftsman.....	1	Packer.....	1
Electrician.....	2	Paperhanger, Painter, and Decorator.....	8
Engineer.....	2	Pattern-maker.....	1
Eye and Throat Specialist.....	1	Photographer.....	1
Evangelist.....	1	Physician.....	3
Farmer.....	295	Plasterer.....	2
Fisherman.....	1	Plumber.....	6
Foreman—City Crossing Department.....	1	Postal Clerk.....	1
Foreman—Field.....	1	Postman.....	3
Foreman—Freight House.....	2	Printer and Binder.....	1
Foreman—Machine Shop.....	6	Pump Repairer.....	2
Foreman—Steel Plant.....	1	Railroad Carpenter.....	1
		Rate Clerk.....	1

Real Estate Agent.....	1	Superintendent—Packing Com-	
Restaurant-keeper.....	1	pany.....	1
Revenue Deputy.....	1	Superintendent—Printing Com-	
Rural Mail Carrier.....	2	pany.....	1
Salesman.....	15	Tailor.....	5
Saloonkeeper.....	2	Tanner.....	1
Scaler in Sulphate Mills.....	1	Teacher.....	1
Secretary—Department Store....	1	Telegraph Operator.....	1
Shipbuilder.....	2	Thresher.....	1
Station Agent.....	1	Tobacco Dealer.....	1
Stationary Engineer.....	1	Tobacco Stemmer.....	1
Stockman.....	1	Traffic Superintendent.....	1
Switchman.....	1	Treasurer.....	1
Superintendent—Coal Mines.....	1	Truck Driver.....	1
Superintendent—Duck Farm.....	1	Undertaker.....	1
Superintendent—Odd Fellows		Water Plant Overseer.....	1
Home.....	1	Wholesale Millinery Dealer.....	1
Superintendent—Old Peoples		Wholesale Wine Merchant.....	1
Home.....	1	Woodworker.....	2

OCCUPATIONAL ACTIVITIES OF THE WOMEN WHOSE PROBLEMS WERE REPORTED

Cateress.....	1
Domestic.....	7
Dressmaker.....	7
Housewife.....	136
Pastry Cook.....	1
Rooming-House Keeper.....	1
Trained Nurse.....	1

was finally decided to follow the plan of accepting only such problems as common-sense and the experience of those familiar with various phases of the work would sanction. All others were rejected. Between 600 and 700 problems were thus thrown out. Several problems about which the writer was doubtful were submitted to professional opinion before they were admitted to classification. This accounts for the fact that several difficult problems appear that can readily be solved by arithmetic, but involve a knowledge of physics and engineering. Problems like the following were considered as unreliable and were consequently discarded:

If a man has 20 customers to call on and 2 are new customers and he sells 600 pounds, what is the average amount sold to the old customers?

Bought \$1.05 worth of meat. It furnished four meals for five people and a remnant worth 10 cents was left over. How much did it cost for each person?

A man has a ditch 100 feet long he wants dug for which he will pay \$100. Two men take the job and each wants to earn \$50. One end of the ditch is hard ground, the other soft. The man who digs the hard portion receives \$1.25 per rod while the man who digs the softer portion receives 75 cents a rod. How many rods must each dig to receive \$50?

What will 1 dozen fence posts cost which are 6 feet long 6 inches square at the long end and 4 inches square at the small end if lumber is worth \$40 a thousand?

Multiply $6/14$ by $7/8$.

TABLE II
SHOWING THE TOTAL NUMBER OF PROBLEMS CLASSIFIED
FROM FOURTEEN CITIES

Classification	Total Number of Problems	Percentage*
Addition.....	318	12.4
Subtraction.....	63	2.5
Multiplication.....	209	8.3
Division.....	138	5.5
All four operations.....	54	2.1
Addition and subtraction.....	189	7.5
Addition and multiplication.....	589	23.6
Addition and division.....	29	1.2
Addition, subtraction, and multiplication.....	222	8.9
Addition, subtraction, and division.....	18	0.7
Addition, multiplication, and division.....	130	5.2
Multiplication and subtraction.....	44	1.8
Multiplication and division.....	87	3.5
Multiplication, division, and subtraction.....	7	0.3
Division and subtraction.....	17	0.7
Total.....	2,114	84.2
Bank discount.....	3	0.1
Board measure.....	10	0.4
Carpeting.....	15	0.5
Commission.....	3	0.1
Cord or wood measure.....	3	0.1
Cubic measure.....	10	0.4
Dry measure.....	8	0.3
Fencing.....	1	0.04
Fractions.....	73	2.9
Hay in stack.....	1	0.04
Hay in mow.....	1	0.04
Insurance.....	2	0.08
Interest.....	31	1.3
Land measure.....	5	0.2
Linear measure.....	12	0.5
Liquid measure.....	10	0.4
Lumber.....	5	0.2
Masonry.....	2	0.08
Mensuration.....	9	0.4
Milk test.....	3	0.1
Papering.....	8	0.3
Percentage.....	97	3.9
Proportion.....	1	0.04
Roofing (other than shingles).....	2	0.08
Shingling.....	2	0.08
Square measure.....	19	0.7
Trade discount.....	48	1.9
Total.....	384	15.18
Grand Total.....	2,498	99.38

* The percentage column at the right shows the percentage of problems under each heading, based on the grand total number, 2,498 problems.

The following problems exhibit more completely the manner in which they were classified. In this study no attempts were made to classify problems with reference to the difficulty of solution. The first two represent clearly the most common type of problems and those most easily solved; those in cubic measure,

masonry, mensuration, and shingling represent the more difficult ones, while the list containing "problems not commonly found in everyday experience" includes the problems most difficult to solve.

Addition.—Bought a pair of boy's shoes for \$4, a cap for 50 cents, a suit for \$12, and a pair of hose for 35 cents. How much was my bill?

Subtraction.—A lady went to the store and bought groceries which amounted to \$5.69. She gave the clerk a \$20 bill. How much should she receive?

Multiplication.—A man sold 3 hogs at 15 cents a pound. The hogs averaged 200 pounds each. How much did he get for his hogs?

Division.—When potatoes are selling for \$1.25 per bushel, how many bushels can I buy for \$10?

All four operations.—I took a load of barley to town. The wagon weighed 1,340 pounds. Barley and wagon weighed 4,310 pounds. At \$2.10 a bushel, how much would the load bring?

Addition and subtraction.—I had a \$10 bill. Out of this I had to pay the light bill which was \$2.43; the telephone bill, \$2.12; and buy some groceries amounting to \$3.27. How much did I have left?

Addition and multiplication.—Find the expense to build a boat, working 6 days a week, for 3 weeks; 2 laborers at \$2.50 a day; 3 blacksmiths at \$3.00 per day; 4 shipbuilders at \$3.50 per day; 3 calkers at \$4.50 per day, including \$100 for other expenses.

Addition, subtraction, and multiplication.—Mrs. Brown bought 3 dozen eggs at 53 cents and 2 pounds of butter at 55 cents. She paid the bill with a \$5 bill. How much should she get back?

Addition, subtraction, and division.—I bought the weekly supply of groceries—1 sack of flour at \$3; 1 dozen oranges at 50 cents; 1 pound of coffee at 30 cents; 1 package of breakfast food at 24 cents; 1 peck of apples at 50 cents; 1 pound of butter at 50 cents; 1 dozen eggs at 48 cents. I returned one-half of the oranges and one-half of the eggs, for which I received credit. How much was my bill?

Multiplication, addition, and division.—We get 12 dozen eggs each week and the eggs are sold at 31 cents per dozen. I make 20 pounds of butter which I sell at 40 cents a pound. How long will it take to pay a grocery bill of \$25 if these prices continue?

Multiplication and subtraction.—I owed the grocer \$5.35. I took to the store 15 dozen eggs and the grocer was paying 30 cents a dozen. How much cash did I have to pay?

Multiplication and division.—I drove 42 miles in a car. Get 11 miles out of a gallon of gasoline. How many gallons are needed and what is the cost if gasoline is 20 cents a gallon?

Multiplication, division, and subtraction.—A farmer sold a load of hay for \$20 per ton. How much did he receive for it if the gross weight was 4,315 pounds and the tare 1,265 pounds?

Division and subtraction.—My grocery bill was \$14.28. I gave the grocer a check for \$15 and told him to give me sugar for the rest of the money. How much sugar could I get at 11 cents a pound?

Board measure.—I bought lumber as follows: 2 pieces each of 156 feet long, 6 inches wide, 1 inch thick; 4 pieces each 12 feet long, 6 inches wide; 2 pieces, 2 inches by 4 inches and 16 feet long. How many feet of lumber did I buy?

Carpeting.—A room is 11 feet 6 inches wide and 14 feet long. What will it cost to cover the floor with inlaid linoleum at \$1.60 per square yard? The cost of laying is 5 cents per square yard.

Commission.—I sold 3 head of cattle at Mr. Brown's sale, receiving \$30 for 1 and \$37.50 each for the other 2. The auctioneer received 1 per cent and the clerk $\frac{1}{2}$ per cent. Find their commissions and the amount I received after deducting their commissions.

Cord or wood measure.—I sold a pile of wood 4 feet wide, 5 feet long, and 9 feet high. How many cords did it contain and what was the price at \$8 a cord?

Cubic measure.—A corn bin is 8 feet wide, 32 feet long, and 10 feet high. How many bushels of corn will it hold, allowing $1\frac{1}{4}$ cubic feet to a bushel?

Dry measure.—How many bushels of oats will it take to feed 4 horses 3 months, feeding them each 3 quarts per day?

Fencing.—I wish to enclose my hog field with a woven wire fence. The field is 30 rods wide and 50 rods long. At 40 cents a rod, how much will the wire cost?

Fractions.—A recipe calls for $\frac{1}{4}$ cup of lard, 1 cup of milk, and $\frac{3}{4}$ cup of chopped nuts. How much of each will I need to make one-half of the recipe?

Hay in mow.—I sold a bent of hay 36 feet long, 12 feet wide, and 16 feet high at \$30 a ton. Allowing 380 cubic feet to the ton, how many tons did I sell and how much did I receive for the hay?

Interest.—I borrowed \$25 at the bank and pay 7 per cent interest. How much interest will I have to pay the bank for the use of the money for 60 days?

Land measure.—How many acres in a field 60 rods long and 30 rods wide?

Linear measure.—How many yards of curtain material will it take for 3 windows 6 feet high, allowing 6 inches for hems and 2 widths for each window?

Liquid measure.—How much milk will our family buy in 1 month and how much is the bill if we buy 3 quarts a day at 7 cents a quart?

Lumber.—What will be the cost of the lumber for a grain bin 20 feet by 30 feet by 12 feet high at \$20 per M?

Masonry.—How many bricks 2 inches thick, 8 inches long, laid flat, will it take to wall a well 40 feet deep, 4 feet in diameter?

Mensuration.—A silo is 27 feet high and the inside diameter is 14 feet. How many tons of ensilage does it contain when full, 40 pounds to the cubic foot? How many days will the ensilage last 27 head of cattle, each receiving 35 pounds a day?

Milk testing.—Sold a can of cream containing 81 pounds. The test was 27 per cent; butter fat was worth 48 cents. How much did I receive for the cream?

Papering.—What will be the cost of papering a room 16 feet long, 12 feet wide, and 9 feet high, deducting 7 yards for a door and 7 yards for a window, if the paper is 48 cents a roll? The paper is a double roll 18 inches wide and 16 yards long.

Percentage.—The invoice price of a bill of goods is \$9 per dozen. The merchant wants to mark these goods so as to make 20 per cent profit after adding 10 per cent to the invoice price for transportation. What is the selling price per dozen?

Plastering.—We wish to plaster one of our rooms which is $16 \times 12 \times 9$. It costs 35 cents a square yard to plaster. How much does it cost?

Roofing (other than shingle).—A shed is 48 feet long and 12 feet wide. How many rolls of roofing will I need if each roll is 108 feet long and 1 yard wide?

Shingling.—How many bundles of shingles must I buy to shingle a shed 20 feet wide, roof $\frac{1}{2}$ pitch, ridge pole 30 feet? The eaves project 8 inches. Shingles laid $4\frac{1}{2}$ inches to the weather. What would be the cost at \$12.50 per M?

Trade discount.—If an oil stove is listed at \$25 and discounts allowed are 25 per cent and 2 per cent, what is the net price to the dealer?

TYPES OF PROBLEMS NOT COMMONLY FOUND IN EVERYDAY EXPERIENCE

How many cubic feet of cement will be needed to lay a 4-inch floor over a circular span 8 feet 3 inches in diameter? How much concrete will be needed to mix the cement if one part of concrete is used for every 4 parts of sand? (*Explanation:* A mixture of 1 cubic foot of cement and 4 cubic feet of loose sand will make 3.59 cubic feet of concrete.)

A man is willing to give a troop of boys a show at 50 per cent rate. If the boys pay \$2.50 a thousand for having the tickets printed and sell them for 25 cents each, and pay a 10 per cent war tax on each ticket, how many tickets will the boys have to sell to gain \$50? The management pays the rental on the film. If the theatre contains 356 seats how many shows will they have to run?

A freight train running at the rate of 25 miles an hour leaves Chicago 8 hours in advance of a passenger train running at the rate of 40 miles. How many miles will the freight train have to travel and how much time will have to elapse before the passenger train overtakes it?

A hood for a stove is 24 inches in diameter and 22 inches high. The diameter of the smoke pipe is 8 inches. Want to make hood 36 inches in diameter and keep the angles *A* and *B* the same in both hoods. How high must the hood be?

Find the indicated horse-power of a steam engine, size 30-inch cylinder, 48-inch stroke, 100 revolutions per minute. Mean effective pressure 78 pounds per square inch.

What is the capacity per hour of a water pump, size water cylinder 10 inches, stroke 14 inches, number of strokes per minute 100? (Express in gallons.)

A shipment of oil consisting of 10 barrels each weighing 534 pounds is to be made from Quincy, Illinois to Novinger, Missouri. The rate on oil to the said station is 15.89 cents per hundred pounds. War tax is 3 per cent of the entire amount of freight. The shipment being sent prepaid, what will be the amount to collect?

A complete record of the occupational activities of those who submitted problems was kept in so far as the occupations were

TABLE III

SHOWING THE CLASSIFICATION OF PROBLEMS COLLECTED THROUGH CITY HIGH SCHOOLS

Classification	Algoma Wisconsin	Des Moines Iowa	Green Bay Wisconsin	Madison Wisconsin	Stoughton Wisconsin	Sun Prairie Wisconsin	Total Number of Problems	Percentage*
Addition.....	1	79	19	18	14	8	139	11.7
Subtraction.....	.....	9	13	5	1	1	29	2.4
Multiplication.....	2	53	10	8	4	.....	77	6.4
Division.....	3	20	12	5	.....	.....	40	3.4
All four operations.....	4	6	6	9	.....	1	26	2.3
Addition and multiplication.....	.....	43	23	39	9	12	126	10.6
Addition and subtraction.....	10	141	61	46	8	8	274	23.0
Addition and division.....	.....	6	.....	1	2	3	12	1.0
Addition, subtraction, and multiplication.....	4	37	41	31	1	18	132	11.1
Addition, subtraction, and division.....	.....	2	1	3	.....	3	9	0.8
Addition, multiplication, and division.....	2	13	4	23	10	.....	52	4.3
Multiplication and subtraction.....	.....	13	5	3	.....	.....	23	2.2
Multiplication and division.....	2	24	4	4	1	.....	35	2.9
Multiplication, division, and subtraction.....	.....	3	1	2	.....	.....	5	0.5
Division and subtraction.....	.....	.....	6	2	.....	.....	11	1.0
Total.....	28	451	206	199	52	54	990	83.6
Bank discount.....	.....	2	.....	.....	.....	.....	2	0.17
Board measure.....	.....	3	2	1	.....	.....	6	0.51
Carpeting.....	2	5	3	.....	.....	.....	10	0.85
Cubic measure.....	1	2	.....	.....	.....	.....	3	0.25
Cord measure.....	.....	.....	1	.....	.....	.....	1	0.08
Commission.....	.....	1	2	.....	.....	.....	3	0.25
Dry measure.....	2	.....	.....	.....	.....	.....	2	0.17
Fencing.....	.....	1	.....	.....	.....	.....	1	0.08
Fractions.....	2	15	6	2	2	.....	27	2.29
Hay in stack.....	.....	1	.....	.....	.....	.....	1	0.08
Hay in mow.....	1	.....	.....	.....	.....	.....	1	0.08
Insurance.....	2	.....	.....	.....	.....	.....	2	0.17
Interest.....	1	7	10	6	.....	.....	25	2.12
Land measure.....	4	1	.....	.....	.....	.....	5	0.42
Linear measure.....	.....	.....	.....	.....	.....	.....	.....	.....
Liquid measure.....	.....	.....	.....	.....	.....	.....	.....	.....
Lumber.....	2	.....	1	.....	1	.....	2	0.17
Masonry.....	.....	2	.....	.....	.....	.....	2	0.17
Mensuration.....	3	1	6	1	.....	.....	2	0.17
Milk test.....	2	.....	.....	.....	.....	.....	2	0.17
Papering.....	2	3	.....	.....	.....	.....	8	0.68
Percentage.....	2	25	14	1	.....	.....	3	0.25
Proportion.....	1	.....	.....	7	1	.....	6	0.51
Roofing.....	1	.....	.....	.....	.....	.....	49	4.16
Shingling.....	1	.....	.....	.....	.....	.....	1	0.08
Square measure.....	4	4	.....	1	.....	.....	1	0.08
Trade discount.....	2	11	8	2	.....	.....	2	0.17
Total.....	33	84	53	27	4	1	28	0.85
Grand Total.....	61	535	259	226	56	55	1,192	100.7

*The percentage column at the right shows the percentage of problems under each heading, based on the grand total number, 1,192 problems.

TABLE IV

SHOWING THE CLASSIFICATION OF PROBLEMS COLLECTED BY PUPILS OF THE SIXTH, SEVENTH, AND EIGHTH GRADES

Classification	Arcadia Wisconsin	Evansville Wisconsin	Horicon Wisconsin	Linden Wisconsin	Manitowoc Wisconsin	Quincy Illinois	Quincy, Ill. (Col. Schl.)	San Antonio Texas	Stoughton Wisconsin	Two Rivers Wisconsin	Total Number of Problems	Per centage*
Addition.....		4	27	4	27	42	4	31	37	3	179	13.7
Subtraction.....			9		10	8		2	4	1	34	2.6
Multiplication.....	1	5	18	3	37	38	4	13	8	5	132	10.1
Division.....		4	6		29	27	16	10	3	4	98	7.5
All four operations.....	2	4	1		8	2		2	3	3	28	2.1
Addition and subtraction.....	1	2	6	1	10	15	9	13	5	1	63	4.82
Addition and multiplication.....	4	5	37	2	93	44	15	87	15	13	315	24.12
Addition and division.....	1			1	5	7	1		2		17	1.30
Addition, subtraction, and multiplication.....	3	2	23	2	19	13	7	19	1	1	90	6.80
Addition, subtraction, and division.....	2	2			1				4		9	0.68
Addition, multiplication, and division.....												
Multiplication and subtraction.....	5	3	1	6	8	30	10	10		5	78	5.99
Multiplication and division.....			5		3	6	3	4			21	1.61
Multiplication, division, and subtraction.....	2		4	1	19	20		3	1	2	52	3.90
Division and subtraction.....		1			2	2		1		2	2	0.15
Total.....	21	32	137	21	271	254	72	195	81	40	1,124	85.83
Bank discount.....											1	0.08
Board measure.....					4					1	4	0.31
Carpeting.....					2	3					5	0.38
Cubic measure.....		2			3	2					7	0.53
Cord measure.....		1						1			2	0.15
Commission.....												
Dry measure.....		2			1	3					6	0.48
Fencing.....												
Fractions.....	1	1			21	10	9	3	1		46	3.55
Hay in stack.....												
Hay in mow.....												
Insurance.....												
Interest.....					1	1		2	1		6	0.48
Land measure.....						2					1	0.08
Linear measure.....			10		1	1					12	0.92
Liquid measure.....			2		1		1	1		3	8	0.61
Lumber.....	1					2					3	0.23
Masonry.....												
Mensuration.....					1						1	0.08
Milk test.....												
Papering.....						1					2	0.15
Percentage.....	1	1	4	1	25	7		6		1	48	3.70
Proportion.....	3											
Roofing.....												
Shingling.....						1					1	0.08
Square measure.....	1		1		3	3					9	0.70
Trade discount.....	2	3	3	1	1	3		7	1		20	1.5
Total.....	9	10	20	2	63	39	10	20	3	6	182	13.99
Grand Total.....	30	42	157	23	334	293	82	215	84	46	1,306	99.82

* The percentage column a. v. the right shows the percentage of problems under each heading, based on the grand total number, 1,306 problems, collected through sixth, seventh, and eighth grades in city schools.

reported. In nearly one-half of the cases the occupation was not reported, but in Table I, which shows the occupational activities, there appears a list of 141 different occupations for men and 7 for women, which is sufficiently large to warrant the conclusion that problems from a group representing so many varied interests would show the kinds of problems people in general are called upon to solve in their daily life.

IV. RESULTS

This study reveals the fact that an overwhelming majority of the problems which arise in daily life are very simple, requiring for solution only the four fundamental operations and their combinations. Table II shows that out of a total of 2,498 problems submitted and accepted from the city schools 2,114, or 84.2 per cent, may be classified under the fundamental operations. The same table shows that 728 of these problems, or 29.1 per cent, are in simple addition, subtraction, multiplication, and division. Table II is simply a summary of Table III which shows the classification of problems collected through the city high schools, and Table IV, which shows the classification of problems collected through the sixth, seventh, and eighth grades of city schools.

The rural districts submitted 4,847 problems which were accepted and classified. Of these 4,161, or 85.92 per cent, were classified under the fundamental operations as shown in Table V. Of the total number 1,505, or 31.07 per cent, are classified under the four processes: addition, subtraction, multiplication, and division. The percentage of problems in the rural districts that are classified in addition, subtraction, multiplication, and division is considerably larger than in the case of the problems from the city. Comparing Tables II and V the problems in both classified under the four fundamental processes and their combinations show a difference of only 2.37 per cent. The classification, therefore, is practically the same in both rural and city districts. This condition is probably due to the fact that in both the rural and city districts the need for arithmetic occurs most frequently in buying and selling.

In order to determine whether there would be any appreciable difference in the classification of problems from a city where interests are of a special type and in a city where the interests are more diversified, a comparison was made between the problems submitted from Quincy, Illinois and Manitowoc, Wisconsin. From

Quincy, where the activities are in shipping, manufacturing stoves, wagons, incubators, wholesale millinery, with agricultural industries well represented, 375 problems were accepted and classified. Of these, 326, or 86.9 per cent, are classified under the four fundamental operations and their combinations. One hundred and

TABLE V
SHOWING THE CLASSIFICATION OF PROBLEMS FROM THE RURAL DISTRICTS

Classification	Adams County Illinois	Henry County Illinois	Iowa County Wisconsin	Total Number of Problems	Percentage*
Addition.....	136	78	29	243	5.02
Subtraction.....	95	10	17	122	2.5
Multiplication.....	493	170	212	875	18.05
Division.....	147	58	60	265	5.5
All four operations.....	40	35	16	91	1.9
Addition and subtraction.....	105	15	8	128	2.7
Addition and multiplication.....	629	249	89	967	19.95
Addition and division.....	16	16	6	38	0.8
Addition, subtraction, and multiplication.....	605	69	24	698	14.4
Addition, subtraction, and division.....	14	1	.....	15	0.3
Addition, multiplication, and division.....	91	88	79	258	5.3
Multiplication and subtraction.....	146	20	23	189	3.9
Multiplication and division.....	134	25	45	204	4.2
Multiplication, division, and subtraction.....	34	2	3	39	0.8
Division and subtraction.....	23	5	1	29	0.6
Total.....	2,708	841	612	4,161	85.92
Bank discount.....	1	.....	.....	1	0.02
Board measure.....	21	.....	4	25	0.5
Carpentering.....	33	2	6	41	0.8
Compound interest.....	.....	1	.....	1	0.02
Compound proportion.....	.....	1	.....	1	0.02
Commission.....	5	4	.....	9	0.2
Cord or wood measure.....	9	1	12	22	0.45
Cubic measure.....	41	12	47	100	2.06
Dry measure.....	12	.....	5	17	0.3
Fencing.....	2	2	16	20	0.4
Fractions.....	33	9	11	53	1.1
Hay in stack.....	2	3	2	7	0.14
Hay in mow.....	2	.....	11	13	0.3
Interest.....	26	9	16	51	1.1
Land measure.....	15	3	9	27	0.5
Lumbering.....	5	2	1	8	0.16
Linear measure.....	8	2	.....	10	0.2
Liquid measure.....	4	1	7	12	0.24
Masonry.....	5	.....	1	6	0.1
Mensuration.....	6	1	16	23	0.5
Milk testing.....	.....	.....	13	13	0.24
Papering.....	24	6	15	45	0.93
Painting.....	4	.....	.....	4	0.1
Plastering.....	2	.....	1	3	0.06
Percentage.....	62	16	24	102	2.1
Roofing.....	3	2	.....	5	0.1
Shingling.....	9	1	2	12	0.24
Square measure.....	25	4	7	36	0.8
Trade discount.....	6	13	.....	19	0.4
Total.....	365	95	226	686	14.08
Grand Total.....	3,073	936	838	4,847	100.00

*The percentage column at the right shows the percentage of problems under each heading, based on the grand total number, 4,847 problems.

thirty-nine problems, or 37.07 per cent of the total, are classified in addition, subtraction, multiplication, and division. Manitowoc,

TABLE VI
SHOWING THE TOTAL NUMBER OF PROBLEMS CLASSIFIED FROM ALL
SCHOOLS BOTH CITY AND RURAL

Classification	Total Number of Problems	Percentage*
Addition.....	561	7.7
Subtraction.....	185	2.4
Multiplication.....	1,084	14.7
Division.....	403	5.4
All four operations.....	145	1.97
Addition and subtraction.....	317	4.3
Addition and multiplication.....	1,556	21.1
Addition and division.....	67	0.8
Addition, subtraction, and multiplication.....	920	12.5
Addition, subtraction, and division.....	33	0.5
Addition, multiplication, and division.....	388	5.3
Multiplication and subtraction.....	233	3.1
Multiplication and division.....	291	3.97
Multiplication, division, and subtraction.....	46	0.63
Division and subtraction.....	46	0.63
Total.....	6,275	85.00
Bank discount.....	4	0.041
Board measure.....	35	0.5
Carpeting.....	56	0.7
Compound interest.....	1	0.001
Compound proportion.....	1	0.001
Commission.....	12	0.2
Cord or wood measure.....	25	0.4
Cubic measure.....	110	1.5
Dry measure.....	25	0.4
Fencing.....	21	0.3
Fractions.....	126	1.7
Hay in mow.....	14	0.2
Hay in stack.....	8	0.1
Insurance.....	2	0.002
Interest.....	82	1.12
Land measure.....	32	0.5
Linear measure.....	22	0.3
Liquid measure.....	22	0.3
Lumber.....	13	0.2
Masonry.....	8	0.1
Mensuration.....	32	0.5
Milk testing.....	16	0.2
Painting.....	4	0.06
Papering.....	53	0.7
Percentage.....	199	2.71
Plastering.....	3	0.04
Proportion.....	1	0.001
Roofing.....	7	0.1
Shingling.....	14	0.2
Square measure.....	55	0.8
Trade discount.....	67	0.9
Total.....	1,070	14.776
Grand Total.....	7,345	99.776

* The percentage column at the right shows the percentage of problems under each heading, based on the grand total number, 7,345 problems.

a city of industries of rather a special type, as shipbuilding, aluminum manufacturing, and excellent harbor and lake trade, contributed 334 problems of which 271, or 81.1 per cent, are classified

under the four fundamental operations and their combinations. One hundred and three of these problems, or 30.8 per cent, are in addition, subtraction, and division.

Estimated on the basis of frequency of occurrence, the findings in the study would indicate that in general the work in the four fundamental operations should receive more attention in our

TABLE VII
SHOWING THE TOTAL NUMBER OF FRACTIONS
OCCURRING IN ALL PROBLEMS

Fractions		Percentage*
1/2	occurred 837 times.....	72.09
1/3	" 49 "	4.22
2/3	" 39 "	3.35
1/4	" 84 "	7.23
3/4	" 63 "	5.41
1/5	" 5 "	0.43
2/5	" 3 "	0.25
3/5	" 3 "	0.25
4/5	" 3 "	0.25
1/6	" 8 "	0.68
5/6	" 4 "	0.34
1/7	" 4 "	0.34
2/7	" 2 "	0.17
3/7	" 2 "	0.17
1/8	" 14 "	1.20
3/8	" 5 "	0.43
5/8	" 3 "	0.25
7/8	" 7 "	0.60
4/9	" 1 "	0.086
5/9	" 1 "	0.086
8/9	" 3 "	0.25
1/10	" 1 "	0.086
2/10	" 3 "	0.25
3/10	" 2 "	0.17
4/10	" 2 "	0.17
6/10	" 1 "	0.086
7/10	" 1 "	0.086
9/10	" 1 "	0.086
1/12	" 1 "	0.086
8/12	" 1 "	0.086
11/14	" 1 "	0.086
1/15	" 1 "	0.086
1/16	" 1 "	0.086
7/16	" 1 "	0.086
7/17	" 1 "	0.086
16/17	" 1 "	0.086
1/20	" 1 "	0.086
1/36	" 1 "	0.086
Fractions occurred 1,161 times		99.876

* The percentage column at the right shows the percentage of fractions under each heading, based on the total number, 1,161 fractions.

schools. Dr. W. A. Jessup, in his study, found that an average of over 70 per cent of county superintendents and superintendents of the smaller towns and cities recommended an increase in attention to these subjects.

One is rather surprised at the relatively small number of problems occurring in interest and insurance while no problems appear

in stocks and bonds, investments, taxes, building and loan and public expenditures. Educational magazines have been emphasizing the need for study of problems in banking, insurance, investments, savings accounts, etc., and many believe that such topics now constitute a considerable part of the arithmetic used by the average person. The writer offers no explanation for the absence of such problems in this study.

Problems in mensuration, cubic and square measure, occasionally arise in connection with farm work, as in finding the cubical contents of silos, bins, cribs, the amount of hay in stacks, sheds, and mows.

A study of the tables reveals the fact that the average person uses only the common tables of measures and weights. They show that time given to the solution of such problems as involve apothecaries' weights, paper folding, the rood, the perch, foreign exchange, etc., might better be given to more practical study.

Table VII shows a classification of all fractions that appeared in the statement of the problems and the frequency of their occurrence. Fractions occurred 1,161 times. The fraction $\frac{1}{2}$ appeared 837 times, which is 72.09 per cent of all the occurrences. The fractions $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{5}$, and $\frac{1}{8}$, occurred 1,091 times out of a total of 1,161 times, or, 93.9 per cent of the total. These fractions appeared in price lists, also in connection with uneven yards in dry goods, in filling recipes, etc. The problems indicate that women have equally as much need for the use of fractions as have men. The following problems illustrate clearly the way in which the most of the problems involving fractions were stated:

One of our fields which we had in barley contained $6\frac{3}{4}$ acres. The field yielded 392 bushels of barley which we sold at \$1.50 per bushel. How many bushels per acre? How much money per acre?

What will be the value of $9\frac{1}{2}$ tons of hay at \$17 per ton?

I bought 4 yards of gingham at 15 cents per yard; $1\frac{1}{2}$ yards of blue cambric at $12\frac{1}{2}$ cents per yard; 1 pair of hose at 50 cents. How much was my bill?

SUMMARY

1. Out of a total of 7,345 actual problems classified from cities and from rural districts, representing the problems that adults are called upon to solve, 85 per cent may be classified under the four fundamental operations and their combinations.

2. Differences in the classification of problems from city and rural districts are negligible; that is, the percentage of problems from both districts that may be classified under the four fundamental processes and their combinations is about equal.

3. A comparison of classification of problems collected from Quincy, Illinois, where the interests are diversified, and Manitowoc, Wisconsin, where the interests are more specialized, shows that the types of problems are substantially the same.

4. This study shows that in actual daily practice people are seldom called upon to solve the problems in compound interest, compound proportion, insurance, painting, plastering, masonry, and bank discount.

5. No problems were received involving taxes, investments, stocks and bonds, equation of payments, averaging of accounts, present worth and true discount, partial payments, foreign exchange, apothecaries' weight, alligation, annual interest, compound and complex fractions, folding paper, troy weight, or the metric system.

6. The fractions $1/2$, $1/3$, $2/3$, $1/4$, $3/4$, $1/5$, and $1/8$, occurred 1,091 times out of a total of 1,161 times, or 93.9 per cent, of all fractions. Fractions occurred most often in the process of multiplication.

7. The problems show that the common tables of measures and weights should be mastered for they are used continually in actual practice.

COMMENTS

1. This study indicates that much of the formal instruction in arithmetic has little or no use in common practice.

2. It is recommended that much less time should be given in the elementary schools to types of problems enumerated in paragraphs 4 and 5 of the foregoing summary. Topics in arithmetic that have become obsolete should be eliminated.

3. Some banks and various business houses make constant use of interest and computation tables, thereby avoiding much of the actual figuring employed at an earlier time. It is suggested that pupils in the elementary schools be taught how to use such tables.

4. More attention should be given to types of problems that arise in the daily occupations of the people, such as problems in the use of fundamental operations and the common tables of

measures and weights. Practical problems in great numbers can readily be collected in any community, and they create an interest and furnish a motive for the work in arithmetic that cannot be aroused through hypothetical problems in a text. Such problems should be used as supplementary material.

5. Dr. W. A. Jessup and Dr. L. D. Coffman, of the Committee on Economy in Time, recommended on the basis of the judgments obtained from 981 city and county superintendents that more time might be wisely devoted to the study of "the social, economic, and arithmetical issues involved in such facts as saving and loaning money, taxation, public expenditures, banking, borrowing, building and loan associations, bonds and stocks, tax levies, insurance, profits, public utilities, and the like."¹

The findings of this investigation would indicate that in such areas as those covered by this survey, much time need not be given to the study of arithmetic as involved in public expenditures, building and loan associations, bonds, stocks, and tax levies, since no problems in these subjects were received. It is not improbable that in large commercial and industrial centers there is a sufficient number of persons interested in these problems to warrant devoting a larger amount of time to their study. Further investigation covering the larger cities seems advisable in order to establish this conclusion.

¹ W. A. JESSUP, "Current Practices and Standards in Arithmetic," *Fourteenth Yearbook of the National Society for the Study of Education*, Part I (1915). Pp. 116-30.